Summary of Testimony:
Copper Mine Rule

Bruce M. Thomson, Ph.D., P.E.

Summary of Qualifications-1

- Education
  - BSCE – University of California, Davis, CA
  - MS & Ph.D., Env. Sci. & Engr. – Rice University, Houston, TX
- Profession
  - Professor of Civil Engineering
  - Director, Water Resources Program
- Areas of teaching & research
  - Water chemistry & treatment
  - Water resources
- Relevant expertise & experience
  - Waste management issues with U, Au, Cu, & coal mine
  - Chemistry & management of acid drainage

Summary of Qualifications - 2

- *Relevant NM Boards & Committees*
  - NM Mining Commission: 2000-2003
  - Underground Storage Tank Committee: 1990-1999, 2009-2010
  - Wastewater Technical Advisory Committee: 2009-Present
- Professional engineer licensure in NM

Areas of Testimony

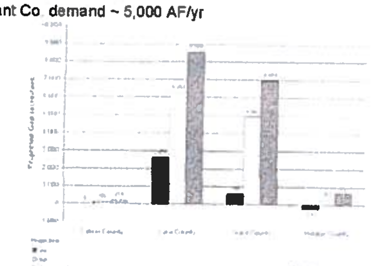
- *Water resources and demand in southwestern NM:*
  - Will show the importance of ground water resources to region
- Challenges of treating high salinity ground water:
  - Will show that a large fraction of contaminated water cannot be recovered for future use

Summary of Ground Water Resources of Southwestern NM

- 90% of potable supply of water (water for consumption) in NM is from ground water sources
  - Importance was recognized early by state leaders resulting in passage of some of first and most comprehensive ground water protection laws and regulations in the country
- *~100% of the potable supply in the southwestern NM planning region* is from ground water
- Grant County ground water use
  - Potable use = 16%
  - Mining use = 69%

Projections for Future Potable Demand

- Projected gap between supply & demand (excluding ag & mining) for 2040 for high & low growth scenarios
  - Current Grant Co. demand ~ 5,000 AF/yr



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Studies to Identify Ground Water Resources for Development

- Johnson et al. (2002) – GW development study to meet future demand
- Romero & Cook (2009) – Study of enhanced recharge to augment supply
- Cuddy, A.S., Keyes, E. (2011) – GW model of Mimbres basin
- DBS&A (2005) – Regional water plan

- Many inconsistencies between reports that are summarized by BOR (2010) in their "Supply & Demand Correlation Report" noted by Mr. Blandford in his rebuttal testimony
- However, all reports show falling water levels in public supply wells throughout region at typical rate of .5 – .75 ft/yr
- Conclusion is that GW resource is limited & new sources of supply are needed

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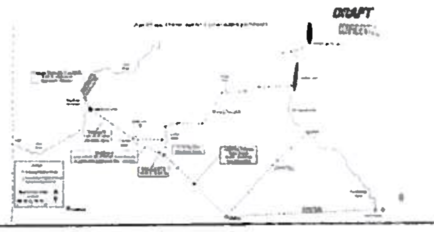
Sources of Supply that Have Been Considered

- New wells and/or improve capacity of existing wells (Johnson, OSE Report 02-04)
- Enhanced recharge with Gila River or other sources (DBS&A, 2005; Romero & Cook, 2009, 2010)
- Use of treated mine water (Roepke, 2007)



Impacts of Climate Change

- *None of the studies reviewed for this testimony address reduced* water supply as result of climate change
- Climate scientists predictions for NM (Gutzler 2012; BOR 2011):
  - Little change in annual precipitation
  - Warming of 1 – 2 C by 2050
- Consequences:
  - Earlier spring runoff
  - Longer growing season hence greater urban & ag demand
  - Increased evapotranspiration
- Conclusion: Significant net decrease in water supply by 2050

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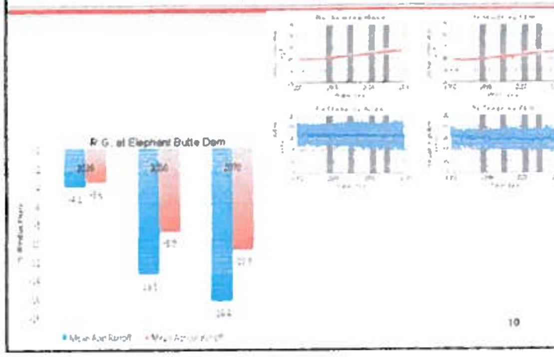
BOR Projections on Rio Grande

(US BuRec, 2012)



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Nature of Contamination from Copper Production

- Principal source of contamination is oxidation of sulfide minerals

$$FeS_{2(s)} + H_2O + O_2 = Fe(OH)_3 + H_2SO_4$$

- Generates acidic low pH water
- Characteristics
  - High concentrations of TDS, sulfate and other constituents
  - Acid may leach toxic metals from soil minerals if present

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Characteristics of Contaminants

- Major contaminants – regulated concentration > 100 mg/L Examples:

Constituent	NM Ground Water Standard (mg/L)
TDS	1,000
Sulfate	600
Chloride	250

- Minor (trace) contaminants – regulated concentration < 10 mg/L Examples:

Constituent	NM Ground Water Standard (mg/L)
As	0.1
Cu	1.0
Fe	1.0
Se	0.05

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Treatment Alternatives - 1

- Minor (trace) contaminants
  - Well established technologies similar to those used for industrial treatment
    - pH adjustment
    - Chemical precipitation
    - Sedimentation and/or filtration
  - Cost effective
  - Produce small volumes of waste which are easy to manage
  - Wastes little water

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Treatment Alternatives - 2

- Major contaminants
  - Requires desalination process – RO, distillation, etc.
  - Desalination of ground water is difficult
    - Expensive & complicated
    - Energy intensive
    - Generates a large volume of concentrate (i.e. brine) that is difficult to dispose of
    - Recovers only 50 – 75% of feed water
- Example: Kay Bailey Hutchison plant in El Paso, TX
  - Treats ground water with TDS ~3,000 mg/L
  - Recovers ~50% of feed water
  - Concentrate is piped 20 miles to deep-well injection field

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Consequences of Treatment

- *Long term expense*
- Permanent loss of large fraction of underlying ground water resource
- Production of high salinity waste stream that is difficult to manage

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NM Case Study - 1
Homestake Uranium mill near Grants, NM

- *Operated from 1958 to 1990*
- Used both acid-leach & alkaline-leach to extract U from crushed ore
- Tailings disposed in unlined pile. 200 acres. 85-100 ft high
- 5 nearby subdivisions
- Homestake provided alternate source of water in 1985

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NM Case Study - 2

- Homestake site placed on NPL in 1982
- Remediation consists of interceptor wells to capture contaminants and treated water injection wells to modify hydraulic gradient
- Treatment by RO & brine evaporation

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NM Case Study - 3

- Q: "Will the community south of the Homestake Site ever be able to use the ground water again?
  A: It is unlikely that the ground water in the alluvial and Chinle aquifers will ever meet the drinking water standards of the State of New Mexico or EPA without adequate water filtration"
  -EPA *Fact Sheet* (2011)
- Two points:
  - The Homestake site demonstrates the impacts of poor management and the difficulty of remediating the problems once created
  - It seems almost certain that if ground water protection criteria are relaxed for copper production other mining operations will demand and likely receive similar accommodation.

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Concluding Remarks

- I believe that mineral extraction and processing can be done safely and cost effectively. Prevention is critical to success of environmental protection.
  - "Consistent with sustainability principles, strategies for dealing with ARD should focus on prevention or minimization rather than control or treatment." -GARD Guide
- I am concerned that the Copper Mine Rule as proposed for adoption by the WQCC:
  - Is not consistent with the WQA and will allow unnecessary ground water contamination
  - Establishes precedent that substantially weakens ground water regulations for other industries subject to the WQA

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